Other States

Other state regulations selected for review include Connecticut, Maine, Massachusetts, New Jersey, Rhode Island and Oregon. The first five were selected from the east coast. Oregon was included by suggestion of a staff member at EPA's Small Flows Clearinghouse (Angoli, pers. comm.). These state regulations are reviewed using the same criteria as the Southeastern states. Much less detail about the suggested level for certain criteria is included in this section since the criteria were extensively discussed in the previous section. The performance of this second group of states is displayed in Table 4.

Lot Size

Only Oregon has a minimum lot size requirement. Oregon's lot size requirement is based not on size, but rather limits the amount of septic tank effluent allowed to be discharged to the soil to 450 gallons per day per acre. This effectively limits density to one and in rare circumstances, two houses per acre. The other states require only enough space for a drain field and in some cases a replacement area in case the first drain field fails.

It is curious that none of the states except Oregon had lot size requirements, especially considering that New Jersey and Massachusetts are considered progressive states with respect to environmental programs (Lester 1994). Available space may be a factor in many of these states. Development may be dense enough that requiring a minimum lot size would be politically infeasible. Or, the states may consider that their respective regulations are stiff enough and do an adequate job of protecting water quality without limiting lot size.

Separation from Ground Water Table

Four of the states, Massachusetts, New Jersey, Rhode Island and Oregon meet the suggested 24-48 inch separation distance. Connecticut and Maine require separation distances of

18 and 15 inches, respectively. These separation distances of less than 2 feet could lead to contamination of ground water.

Water Body Setback

All states met the 50-100 foot setback suggested by EPA and experts (EPA 1993, Rubin pers. comm.). Rhode Island requires a 200 foot setback from areas of special consideration, such as coastal ponds and water supply reservoirs.

Loading Rate

Each of the states reviewed required loading rates which were far smaller than those suggested by EPA and far smaller than those required by the Southeastern states. Note that, as mentioned above, smaller loading rates increase the effectiveness of soil waste water treatment and, thus, decrease the chance of ground and surface water pollution.

Maintenance and Inspection Requirements

Like the Southeastern states, none of the states reviewed in this section required any sort of periodic maintenance.

Regulations Regarding Systems Installed Under Existing Regulations

Maine, Massachusetts, Rhode Island and Oregon. require malfunctioning systems to be upgraded to meet current policy. Connecticut and New Jersey require only an abatement of the problem.

Protection of Coastal Resource Areas

Maine does not allow the construction of conventional systems on dune or beach sand in the immediate coastal zone. Instead, systems must either be constructed with a sand or peat pre-

TABLE 4. Conventional Septic System Regulations for Other Selected States in the Coastal Zone.

	LOT SIZE	DEPTH TO GROUND WATER	WATER BODY SETBACK	LOADING RATE++ (gpd/ sq ft)	MAINT. AND INSPECT.	POLICY ON OLD SYSTEMS	SPECIAL COASTAL PROTECT.
CONNECTICUT	drain field + 100%	18"	50'	0.80 (5 mpi) 0.60 (15m/i)	No	No Upgrade	No
MAINE dune sand	drain field	15"	100'	0.25 (sand)	No	Upgrade	Yes
MASSACHUSETTS	drain field + 100%	48"	50'	0.83 (5 mpi) 0.43 (15m/i)	No	Upgrade	No
NEW JERSEY	drain field	24-48"	50'	0.62 (3-15 mpi)	No	No Upgrade	No
RHODE ISLAND	drain field	36"	50'	0.59 (5 mpi) 0.43 (15m/i)	No	Upgrade	Yes
OREGON	450 gallons per day	48"	100'	0.60-1.50 (all sands)	No	Upgrade	No
EPA SEC. 6217 RECOMM.	site-specific	36"	50-100'	1.20-0.80 (all sands)	Yes	Not Specific	Yes

++ The regulations determine loading rate by one of two methods: textural classification and percolation rate. Loading rates determined by textural classification are shown for sandy soils. Loading rates determined by percolation test are shown for percolation rates between 5 and 15 minutes per inch, which is the expected percolation rate for sandy to loamy soils.

treatment filter or a pressure distribution system. In addition, the lot owner must get an additional permit from the Department of Environmental Protection.

Rhode Island provides special protection for resources located in the Coastal Pond Critical Resource Area, which constitutes the western half of the Rhode Island coast. Systems located in this area must meet more stringent requirements for ground water separation and set back distances.

Interesting Features

Several states have innovative features in their state regulations that merit further discussion. These innovative features are summarized in Table 5.

Texas: Restrictions on Use in Pollution Sensitive Areas

An interesting feature of the Texas regulations is that they authorize pollution control agencies to control or prohibit the use of septic systems in areas sensitive to nutrient and bacterial contamination (Texas NRCC 1993). In essence, the Texas rules make a formal regulatory connection between water body quality and septic system regulation. Not only are septic systems acknowledged as a source of water pollution, but like other sources of water pollution, i.e. point discharges, their use can be restricted near sensitive waters.

Another interesting feature of the Texas regulations is their value as an educational tool. The manual describing the Texas regulations (Texas NRCC 1993) is written in a very accessible, even prosaic, style. Instead of tediously detailing specific rules, it educates the reader about the history of septic system use (p. 5), facility owner responsibility (p.6), regulatory agencies involved (pp.6-7), as well as technical details of septic system construction (Sections 285.51-285.63).

Aggressive Development of Alternative Systems: Florida

All states reviewed in this paper allow the use of alternative systems where sites are unsuitable for conventional systems. However, the state of Florida has put a substantial amount of effort into the development of new alternative systems.

Florida, with Texas, has the most stringent septic system regulations in the Southeast. As a result of these regulations and high water tables throughout the state, many areas are off limits to conventional septic systems. Florida also has one of the fastest growing populations in the country. This expanding population has created a large demand for septic systems. It is estimated that 60,000 new septic systems were installed annually during the 1980's (Barranco and Sherman, 1991). In an effort to satisfy the demand for development of properties out of the reach of sewer hook-up while enforcing the stringent state regulations, Florida has implemented an aggressive program to promote the development of innovative systems. These innovative systems are designed to function satisfactorily in areas unsuitable for conventional systems.

The objectives of the Florida program are to balance the development of innovative systems with the protection of public health and the environment. Manufacturers are encouraged to apply for approval to use a new system state-wide. During the application process, the manufacturer must submit supporting literature, scientific data, etc., on the system's performance. If the state approves the application, the manufacturer is allowed to install a limited number of "experimental" systems on lots within the state. The state designs and implements a testing and monitoring program to assess the performance of these "experimental" units. Upon the completion of the monitoring period, the state either approves or denies the system as an alternative for state-wide use.

The interesting aspect of Florida's approach to septic system management is that the state has implemented stringent regulations, but then worked to offset any limitations this policy would place on land use by developing options for owners to use on sites with limiting soil or environmental conditions. It is possible that Florida has been able to satisfy two often conflicting objectives for septic system management, the protection of public health and environment and the minimization of impediments to development.

It should be noted that one public health administrator has criticized Florida's program as too liberally approving alternative systems, the result being frequent ground and surface water

contamination from ineffective technologies and designs (Calk, pers. comm.). I have found no evidence which either corroborates or disputes this claim.

Table 5. Innovative State Policies and Local Programs

Jurisdiction	Feature
Texas	Regulatory Connection between Water Quality and Septic System Use
Florida	Stringent Regulations Offset by Aggressive Development of Alternative Technologies
Maine	Integrated Siting and Design Factors
Oregon	Regulations Based on Carrying Capacity of Local Environment
Kerr County, Texas	Comprehensive On-Site Management at the Local Level

Maine's Procedures for Variance: Integrating Siting and Design Factors

If a system cannot be installed in compliance with Maine regulations, the landowner must apply for a variance. Instead of evaluating the site in question according to subjective criteria on a site by site basis or according to hardship, which is the case with variance procedures in most states, sites are evaluated using a scorecard. The scorecard assesses the site with respect to soils, ground water separation, lot size, terrain, waterbody setback, type of water supply, size of the system, design flow and the presence of additional on-site treatment devices. Each site is given scored on each of these factors (and scores can be negative). The maximum score a site can receive is 100. A score of 50 is required in non-coastal areas, and 65 in coastal areas (Maine DEP 1983, Hoxie et. al. 1987).

The interesting thing about Maine's variance procedure is that it recognizes the interdependency of many factors in determining the risks presented by any individual system. For instance, on 20 acre lots, far from a water course, a 10 inch separation distance between the bottom of the drain field and the ground water table may not present a serious risk. On a coastal property with 1/4 acre lots and a 50 foot setback, a 10 inch separation distance my be very

serious. The Maine variance procedures allow for tradeoffs between different factors in deciding whether a site is suitable for a septic system.

Though Maine's procedures apply only to applications for variances from the state regulations, it is conceivable that such a system could be incorporated into a state or county's standard siting procedures for all on-site units. Such a program would offer flexibility and, if properly designed, a more accurate calculation of risk.

Oregon: Carrying Capacity

Though the Texas regulations allow pollution control agencies to limit septic system installation near sensitive waters, the Oregon regulations go one step further and actually set limits for septic system design and use near sensitive ground waters. The Oregon regulations set two types of limits on use: siting and design limits, and discharge limits.

Siting and location limits are used on lands overlying the Alsea Dunal and Clatsop Plains aquifers on the Oregon coast. The rules basically allow for variances that allow systems to be sited with less of a ground water separation distance and with a less strict density requirement, if certain additional measures are taken to protect water quality. These additional measures include installing a pressurized distribution system (see section 1.4, introduction) and requiring a much lower loading rate. The rationale for these variances is an attempt to balance development pressures with environmental protection. The Alsea and Clatsop aquifers are not used for drinking water. Consequently, according to the Oregon regulations, a higher risk of pollution loading is acceptable. The regulations do provide additional provisions that if the Alsea aquifer is degraded or developed as a drinking water supply, central sewage collection will be required.

Oregon provides discharge limits for systems located on the North Florence Dunal aquifer along the central Oregon coast. According to the regulations, a system must not in itself contribute, or in combination with other new sources contribute more than 58 pounds per acre nitrate-nitrogen to the ground water. It is unclear how the contribution of nitrate-N to the ground water is to be measured. Using 17 g N per day as the average amount produced per person

(Kaplan, 1987), a household of four would contribute 55 pounds of nitrogen to the septic system drainfield. If this is the case, the limit on septic system density would be one household per acre.

What make Oregon's siting requirements with respect to the three coastal aquifers above interesting, is that these requirements are based upon carrying capacity. In the case of the Alsea and Clatsop aquifers, restrictions on the use of septic systems is based qualitatively upon the intended use of the ground water aquifer. In the case of the North Florence aquifer, level of use is determined by the estimated pollutant absorption capacity of the aquifer. The merits of Oregon's approach is that intended use and pollutant loading are considered before siting. It is conceivable that a jurisdiction wanting to balance development with environmental protection would want to consider both of these factors in setting septic system policy.

An Innovative Local Government Program: Kerr County, Texas

Although not located in a coastal area, Kerr County, Texas' on-site wastewater disposal program helps to illustrate the range of activities that a county may undertake in implementing a septic system management program.

As mentioned previously, Texas' regulations are among the most stringent in the Southeast. Under existing state regulations, 95% of the land area of the county is unsuitable for the use of conventional septic systems (Carlile, 1991). Existing systems which were installed under old, less stringent regulations are blamed for contamination of the Guadelupe River, which bisects the county. To allow development to occur on a wider range of sites and to address problems with existing systems, the county designed a comprehensive septic system management program. The components of Kerr County's program that are most interesting include: (1) policies regarding existing systems, (2) policies regarding the development of alternative systems and (3) its operation and maintenance program.

Existing systems (about 10,000 systems) are granted permits for five years while a comprehensive inspection and monitoring program is implemented to assess the contribution of

these systems to ground and surface water pollution. Existing systems judged likely to be polluting ground and surface waters are required to implement a water conservation program as a condition of their permit. Systems which are obviously malfunctioning are required to be repaired using alternative technologies which address site restrictions. Moneys for repair are to come from an operation and maintenance fee imposed on all on-site users (Carlile, 1991).

To encourage the use of alternative technologies, selected alternative systems were installed as "experimental" systems in different soil types within the county. In an effort similar to the Florida program, the performance of these experimental units was monitored for a period of time and approval or denial for use of the systems county-wide was granted based on performance.

Finally an inspection and maintenance program was instituted. Alternative technologies require more maintenance and repair than conventional systems (Myers et. al 1991, Brown et. al. 1991). To ensure that alternative systems are adequately maintained by owners, a program of regular inspection of new and upgraded systems was proposed. This program was to be funded by a fee of $120-150 per year levied on all residents in the county. This fee was dropped, however, due to political pressure. Instead, the periodic maintenance and repair program is being operated under a grant from the Texas On-Site Wastewater Research Council (Carlile 1991).

Kerr County has developed an innovative program which addresses several specific problems often encountered by communities experiencing difficulties with septic systems: it addresses problems with existing septic systems, many of which have been installed under previous, less stringent regulations; it seeks to reduce barriers to development by promoting the safe use of alternative systems in areas unsuitable for conventional systems; and it proposes to a maintenance and operation program to ensure that septic systems are functioning properly.

The impetus for Kerr County's program was the fact that many of the lands in the county were undevelopable under existing state regulations. The increase in tax base which would come from additional development in the county was an effective incentive for the county to develop a comprehensive program which satisfies the state regulations, protects public health and the

environment and while reducing barriers to development. A similar program has been implemented in Craven County, North Carolina (Carlile 1991).

5. Case Study: The Charleston Harbor Project Area

Study Area

Physical Description

The Charleston Harbor Project Area is located on the South Carolina Coast, approximately 70 miles north of the Georgia border (Figure 2). The Area, which incorporates most of the drainage for the Charleston Harbor estuary, includes the majority of Berkeley, Dorchester and Charleston counties as well as the city of Charleston. The Project Area was delineated by NOAA and the state of South Carolina in 1991. A management entity, the Charleston Harbor Project, was funded by NOAA and located within the South Carolina Coastal Council, for the purpose of investigating the impacts of development on water quality and implementing policies to protect the quality of the estuary and other coastal resources.

The focus of this study is local communities on the islands that rim the coast of the Project Area. These islands are, the Isle of Palms, Johns Island, James Island, Kiawah Island, Wadmalaw Island and Sullivan's Island. (Figure 3). These islands are all located within Charleston County's jurisdictional boundaries. These geographic areas are islands in that they are surrounded on all sides, and often bisected by, estuarine or coastal waters.

Environmental Conditions

The Soil Conservation Service, in their soil surveys of counties within the U.S., indicates the suitability of soils for septic systems. Most soils on the islands are unsuitable for septic systems, either because of their high permeabilities and low filtering ability, or because of a high water table (SCS, 1971). Forty to fifty percent of the soils on the island are tidal marsh. The remainder of the soils fall into several soil series. The Crevasse series is the most extensive in area. This soil has severe limitations for septic systems because of low filtering action (i.e. coarse sands). Of the remaining soil series, only two, the Hockley and Wando series are identified as

Figure 2. The Charleston Harbor Project Area

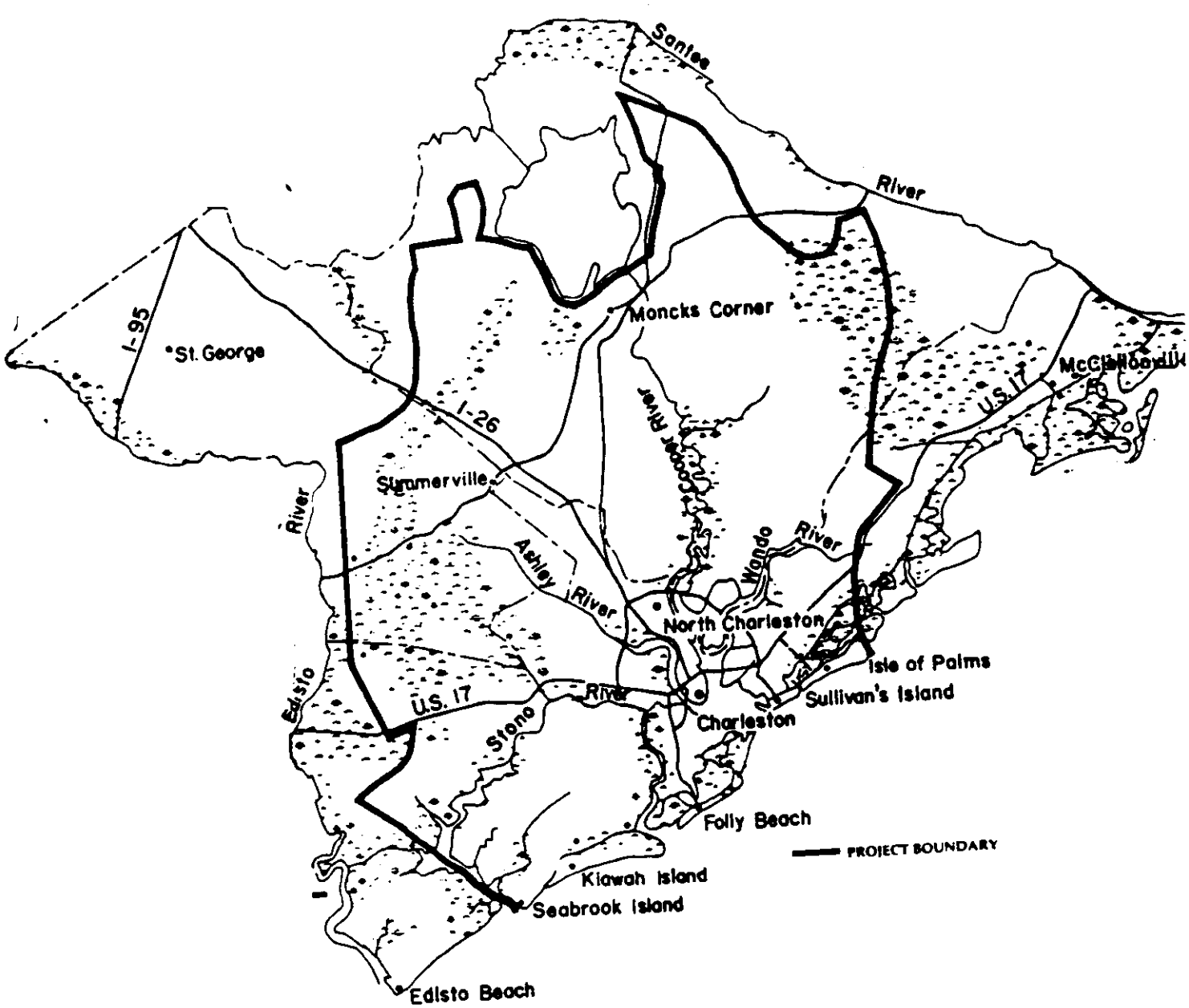
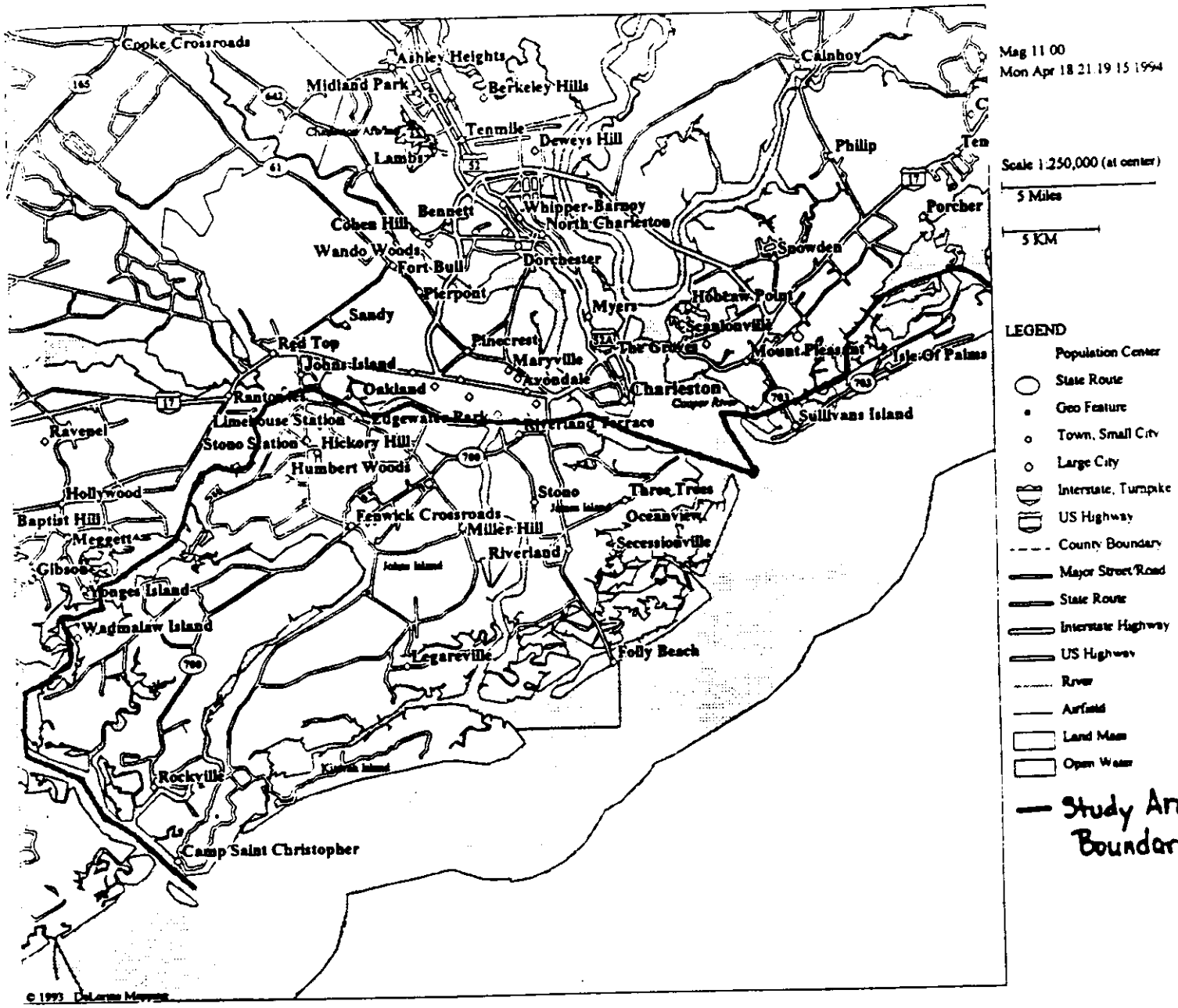


Figure 3. Islands in the Charleston Harbor Project Area



having slight limitations. These series cover a very small percentage of the island (<<10%). The Kiawah, Charleston and Seabrook series are identified as moderately limiting, because of high water tables. Systems located on these soils would require a shallow drain field to allow for any sort of separation between the drain field and ground water.

Current Status: Water Quality and Septic System Policy

Water Quality

Shellfish waters in the Charleston Harbor are in relatively poor condition compared with the rest of the state (Table 6). Of the 24,000 classified acres, none are approved; 5,000 acres (21%) are conditionally approved, which means shellfish can be harvested, except for several days after rain storms (which flush fecal material out of the soil and into the estuary); 2,000 acres (8%) are restricted, which means that shellfish can be harvested if they are subject to a two day purification or depuration process in clean waters; 17,000 acres (71%) are prohibited, which means shellfish cannot be harvested at any time (NOAA, 1990). In comparison, 69% of state waters are approved, with only 17% prohibited (NOAA, 1990).

Septic systems are identified by NOAA and the state shellfish sanitation agency as one of the five pollution sources responsible for the impairment of shellfish waters. The other pollution sources are sewage treatment plants, industry, urban runoff and boating. NOAA and the state shellfish branch attribute a comparable level of pollution from each of these sources (NOAA, 1990).

Table 6. Water Quality: Charleston Harbor versus the State of South Carolina

	Charleston Harbor		South Carolina	
	Acres (x 1000)	Percent	Acres (x1000)	Percent
Status				
Approved	——	0	200	69
Conditionally Approved	5	21	9	3
Restricted	2	8	32	11
Prohibited	17	81	50	17

Source: Department of Commerce, National Oceanic and Atmospheric Administration, *1990 National Shellfish Register of Classified Estuarine Waters*.

Septic System Policy

Septic system policy in Charleston County, the county which contains the islands which are the subject of this case study, is similar to that for the state of South Carolina (see Table 4). The county requires a six inch separation distance between the drain field and ground water, a fifty foot setback from water bodies, and loading rates in accordance with EPA recommendations. The county has no inspection and maintenance program and no special provisions to protect coastal waters. Existing systems that are failing are not required to be upgraded to current state regulations unless absolutely necessary. Instead, the owner is required to perform repairs necessary to abate the problem. The county regulations differ from the state regulations with respect to minimum lot size. The county requires a minimum lot size of 12,500 sq. ft. (0.3 acre) if the lot is served by a public water source and 30,000 sq. ft. (0.7 acre) if served by a private well.

In 1993, EPA and NOAA reviewed the state septic system regulations as part of a preliminary review of the state's coastal nonpoint source program under section 6217 of the Coastal Zone Management Act. Three criticisms were made of existing policy. First, the six inch separation distance to the ground water table was considered "insufficient both for providing a

sufficient contact zone for treatment and for protecting ground water" (EPA/NOAA 1993). Second, existing regulations do not identify areas where the location of systems will likely result in water quality impairments and require special protective measures to prevent degradation of these waters. Third, the state has done little to identify areas where failing systems exist or where systems are likely to fail in the future. EPA/NOAA recommends that the state address these criticisms by updating state policy (EPA/NOAA, 1993).

The Charleston Harbor Project and Their Goals

The Charleston Harbor Project (CHP) is a watershed planning agency funded by NOAA and located within the South Carolina Coastal Council, South Carolina's coastal management agency. CHP's mission is to examine how projected growth and development in the Charleston Harbor Project Area will impact estuaries, land use and other coastal resources. CHP's objective is to develop and implement policies which protect the environment and allow for the continued use of the Harbor's waters and natural resources (CHP, 1992).

CHP is interested in working with county, town and city agencies to strengthen septic tank regulations on islands in Charleston Harbor. As mentioned in the review of state policy, South Carolina's regulations are, with Virginia's, the weakest in the Southeast. EPA and NOAA have criticized this lack of stringency in state policy. Charleston County, though more progressive than the rest of the state in that it requires minimum lot sizes for septic system installation, still requires only a six inch separation distance between drain field and ground water. The Charleston Harbor Project would like to strengthen the regulations on septic systems in the coastal zone so that they more adequately protect coastal resources. Specifically, they would like to implement a policy which balances development with environmental protection. If successful in their efforts, this policy could become a model for other coastal areas in South Carolina and contribute to NOAA and EPA's approval of South Carolina's coastal nonpoint source management plan.

Several constraints and barriers exist to the implementation of more effective septic system regulations in the Charleston Harbor area. Using the framework presented in the introduction

(Table 1), I will examine these constraints below. I will then examine the implications of these constraints with respect to implementing more stringent regulations and present a set of policy recommendations.

Constraints to Policy Implementation

Regulatory Culture: Attitudes Towards Septic System Regulations in South Carolina

Land use regulation is not politically popular in the South (Healy, 1985). And South Carolina is no exception. Septic system regulations, because they are often the only form of land use regulation in rural and suburban areas, have been politically contentious in South Carolina (Calk pers. comm., Montgomery pers. comm.). For instance, when South Carolina updated its septic system regulations in 1978, it required a minimum lot size of 12,500 sq. ft. on lots served by public water supply and 30,000 sq. ft. on lots served by private wells. Under intense political pressure, these regulations were dropped (Calk, pers. comm.). The 1983 regulations provide no such provisions for minimum lot size. State and county on-site wastewater administrators refer to this event as an indication of the unfavorable political climate that exists regarding stricter septic system regulations (Calk pers. comm., Montgomery pers. comm.).

While the state as a whole may be resistant to changes in septic system regulations, the regulatory climate in the Charleston Harbor Area, especially the islands in the harbor may be more favorable. Charleston County, has shown itself to be more progressive than the rest of the state (Calk, pers. comm.). For instance, when minimum lot sizes were dropped from the state regulations, they were retained in Charleston County. Income, education and housing values are substantially higher than the rest of the state (US Census 1990, see section on socioeconomic conditions below). The value that these residents place on environmental protection, especially the protection of resources that provide aesthetic and recreational amenities close to their place of residence, may be higher than the rest of the state. According to Heyward Robinson, director of the Charleston Harbor Project and a resident on the barrier islands, the residents that live on

barrier islands in the Charleston Harbor pay a "pretty penny" to do so. He believes that these residents will be interested in protecting the shellfish and estuarine waters next to their homes.

The Role of Federal, State and Local Governments

The Federal Government

As mentioned in section 2, the role of the federal government with respect to septic systems has been indirect. The Coastal Zone Management Act Amendments of 1990 require coastal states to submit nonpoint source management programs, which must include provisions to ensure that septic systems pose little risk of surface water contamination. EPA and NOAA, as discussed above, were critical of several aspects of South Carolina's existing policy, and suggested the policy be updated. It is unclear at this time whether EPA/NOAA will require an update of these regulations before South Carolina's program can be approved. If they do require an update of current policy, it is unclear how much of a change will be required. Staff at EPA have suggested that the approval process for coastal nonpoint source programs will be stricter than the rather lenient process that characterized the approval of state management programs under the Coastal Zone Management Act of 1972.

Role of State and County Governments

Administrators of on-site wastewater management programs at both the state and county level believe that existing regulations are doing an adequate job of protecting public health and the environment (Calk pers. comm., Montgomery pers. comm.). These administrators also assert that any change in regulations that affects development (i.e. separation to ground water table, density) will be politically contentious. There appears to be little chance that the state will change regulations at the state level unless required to do so by EPA/NOAA (Robinson, pers. comm.).

Although the Tri-County health department believes existing regulations are adequate, it is clear that they see their duty as implementing any regulations decided upon by state, county or

local governments. While the health department will most likely not be an active proponent of changes in the regulations, it will implement any changes to the best of its abilities.

It is interesting to note that a policy option that may satisfy EPA/NOAA's recommendations for more stringent septic system policy in the coastal zone and circumvent political inertia at the state level is the implementation of more stringent policy only in coastal counties in state, perhaps only in the immediate coastal areas of these coastal counties. If this is the case, the approach being pursued by the Charleston Harbor Project, i.e. working with local governments to strengthen policy in the immediate coastal zone of Charleston County, could be a model for efforts along the entire coast of South Carolina.

Technical Difficulties

Sewers versus A Comprehensive On-site Policy

Some communities on the barrier islands are already hooked up to sewer. For instance, more than 90% of households on Sullivan's Island, in Kiawah Island Town, Seabrook Island Town, and Mt. Pleasant are connected to centralized sewer (US Census, 1990). However, there are more than 8,000 existing septic systems on the islands, with many areas not serviced by sewers. An ongoing debate in South Carolina, as well as other coastal states, has been whether to extend sewer into areas currently unsewered, or to stay with septic systems (Robison, pers. comm.). No decision has yet been made to extend sewer service to all areas currently not serviced.

Gaps and Uncertainties in Scientific Knowledge

No conclusive evidence has been gathered about the specific effects of septic systems on coastal waters in the Charleston Harbor area. NOAA has estimated that septic systems are responsible for approximately 23-39% of shellfish closures in the Southeast (Ehler, 1988). The state and the Tri-County health department, which serves Charleston County, believes that the effects of septic systems are much less than 23-39% in their area. Steve Calk, director of on-site management at the Tri-County health department, cites sewage treatment plants upstream which are violating their discharge permits as the major cause of bacterial and viral contamination of coastal waters (Calk, pers. comm.). No evidence currently exists to corroborate whether the effects of pollution are in line with NOAA or state and local health department estimates.

As mentioned in section 2, because the impacts of septic system impacts on water quality are circumstantial, the decision as to whether septic systems are problem becomes political. Once a jurisdiction makes a decision one way or another, all subsequent observations may be likely to support or corroborate this decision (Clark and Westrum, 1987). Research may be engaged in to support this decision. This may be the case with the state and some local governments in South Carolina. The state feels that existing regulations are adequate to protect water quality (Montgomery, pers. comm.). The Tri-County health department is of the same opinion (Calk, pers. comm.). While no evidence exists that septic systems are causing a problem, the reason for this lack of evidence may be a lack of research and observation.

In EPA/NOAA's critique of South Carolina septic system policy, one point of criticism was the lack of an ongoing program "to identify areas where failing systems exist and where systems are likely to fail in the future." (EPA/NOAA 1993). Additionally the Tri-County health department is currently engaged in a study aimed at assessing the contribution of sewage treatment plants to bacterial contamination of surface waters. The health department claims that preliminary results of this study show that sewage treatment plants are likely to be responsible for substantially more water pollution than septic systems. In sum, the local health department does

not appear to be looking for instances where septic systems have failed, and may even be looking for evidence that they do not contribute as much pollution as commonly thought.

To remain objective, I must allow the possibility that septic systems in the Charleston Harbor Project Area are not contributing to the contamination of ground and surface waters and that South Carolina's regulations are indeed doing an adequate job of protecting public health and the environment. However, I must point out that the contention that a six inch separation distance to the ground water table is adequate to protect against ground and surface water contamination contrary to the results of field performance tests and the opinions of experts (Rubin pers. comm., EPA 1993, Cogger 1988, Kaplan 1987, Carlile 1985, Hagedorn et. al. 1981). I must allow the possibility that a problem has not been found because it has not been looked for.

Though the contribution of sewage treatment plants in the Charleston Harbor Area may be substantial, the contribution of septic systems in absolute terms (i.e. total pollutant load) may also be substantial. Once these treatment plants are brought into compliance with their NPDES permits, the problem with septic systems will still exist. No evidence exists on the total pollution load delivered by septic systems to surface waters. Given the leniency of state regulations, it is likely to be very high when compared to other areas in the Southeast.

Septic System Problems of a Socioeconomic Nature

The total population of the islands is approximately 43,500, 75% of which are Caucasian and 25% of which are African American. As opposed to many barrier islands in the Southeast, the majority residents live on the islands the entire year (US Census 1990). Most residents work off the islands, commuting to Charleston or the county mainland (US Census).

The cost of living on the islands is very high. Median housing values range between $65,000 (Wadmalaw Island, pop.2569) and $215,000 (Sullivan's Island, pop. approx. 2000). Median housing value for the state is $60,000 (U.S. Census).

There is a wide racial disparity regarding income and education on the island. Average per capita income for whites ranges between $15,000 and $35,000, depending upon community,

whereas for African Americans, it ranges between $6,000 and $10,000. Many white residents on the island have a baccalaureate degree or higher, whereas a similar percentage of African American residents have not finished high school. (US Census 1990). Income levels are much lower in areas served primarily by septic systems. In the past, some low-income communities have had septic system problems that have led to the contamination of surface waters (Robinson, pers. comm.).

If local governments enact more stringent regulations, it is likely that conventional systems will be statutorily infeasible in many areas where they are currently allowed (Montgomery, pers. comm.). In these situations, the only option will be the use of alternative systems or technologies, which are much more expensive than conventional systems (EPA 1993). Sites which require alternative systems will be off limits to those who cannot afford them. Consideration must be given to the possibility that increasing the stringency of the regulations without providing assistance for low income individuals could effectively price these individuals out of certain land markets.

One aspect of current South Carolina policy that is favorable to low income residents is its policy regarding the repair of failing systems. Current policy does not require owners to upgrade failing systems to current state regulations. (As mentioned in section 3, a policy requiring upgrade can be unreasonably costly and disruptive to low-income households). Instead, current policy only requires the existing problem be abated, by any means necessary, regardless of existing site conditions. This policy has the potential to minimize costs and other impacts to low income residents, while still reducing public health risk. In addition, according to the Tri-County health department, since hurricane Hugo, grant and aid moneys have been available to assist low income households in repairing their septic systems (Calk, pers. comm.)

While this part of South Carolina policy may be desirable because it avoids placing unreasonable burdens on low-income individuals, these merits should not be the only consideration when deciding upon a policy regarding existing systems. A policy requiring upgrade is better from a public health and environmental perspective and may be essential where existing

systems were permitted under extremely lenient regulations. A policy requiring upgrade would not be an undue burden on middle and upper income households. A viable policy option may be a policy requiring upgrade with a variance in cases of economic hardship.

Adequacy of Resources

Changing septic system policy, if it involves a program of regular inspection, will involve additional duties for the local health department. Changing policy may also demand technical experience with alternative and innovative technologies. It is critical that the local health department have available the resources to provide any additional services.

It is unclear at this time whether local governments on the barrier islands would create and staff their own health department or implement any changes in regulations through the Tri-County health department. Determining the best choice of management entities and financing arrangements is beyond the scope of this paper. These choices should, however, be considered before a policy is implemented.

If the county or local governments decide to administer changes in policy through the Tri-County health department, they will be able to take advantage of existing infrastructure and expertise. Steve Calk, director of on-site waste water management, is experienced and very knowledgeable about alternative systems and technologies and about septic system management policies throughout the Southeast. From a technical perspective, the Tri-County health department should be able to implement any changes in policy without difficulty.

Sound Theoretical Basis: Problems with Existing Policy

Current policy in South Carolina has two shortcomings with respect to scientific criteria: (1) inadequate separation between drain field and ground water and (2) lack of a means to bring existing systems contributing to pollution up to current regulatory standards.

South Carolina requires only a six inch separation between the drain field and ground water, which is clearly inadequate to properly treat effluent before it is discharged in to the

ground water table. The coarse sands, combined with a small separation distance are unlikely to provide substantial filtering of bacteria, viruses and nutrients (Rubin, pers. comm.) Evidence and experts suggest two to four feet (Rubin pers. comm., EPA 1993, Perkins 1989, Cogger 1988)

The state also has no mechanism to bring failing systems up to current regulations. Key to the effective management of septic systems the Charleston Harbor Project Area is remedying problems with existing systems. Before 1978, South Carolina had no regulations regarding depth to ground water and setback from water courses (McCall and Meadows, 1988). Sixty-six percent of the houses on the islands were built prior to 1979 (U.S. Census, 1990). Systems installed after 1978, only require the six inch separation distance. Systems which malfunction or show obvious signs of contributing to water pollution should be required to at least meet the separation distance under whatever policy, current or modified, is in place at the time of violation.

If a new policy is put in place, it may still be difficult to identify systems contributing to ground and surface water contamination. Because these systems are located on coarse sands, it is unlikely that they will show obvious signs of malfunction. Coarse sands are highly permeable. Clogging of the drain field and subsequent ponding of effluent is unlikely to occur in this substrate (Jenssen and Siegrist, 1991). Instead, the most likely vehicle for pollution from these systems is for wastewater to pass through the coarse sands with minimal treatment and pass directly into the ground water table. These systems, to all outward appearances, may be functioning normally. The only way to identify systems potentially causing pollution is through the use of monitoring wells or by reviewing installation records to identify areas where systems may have been located in less than ideal circumstances.

Implications

There are several implications that can be drawn from the examination of constraints to policy implementation in the Charleston Harbor Project Area.

First, any effort at changing policy must take into account the political climate in South Carolina. In the past, efforts to institute stricter regulations have met staunch political resistance.

The state seems unlikely to change regulations at the state level. Local and state on-site waste water management agencies perceive the issue as contentious and seem unlikely to be outspoken proponents of change. The role the federal government will play is unclear at this time.

Though the political climate in South Carolina is unfavorable, attitudes on islands in the harbor may be more favorable. Residents reportedly value their existing quality of life on the islands and may support regulations which contribute to the aesthetic and recreational value of waters near their places of residence.

Given political attitudes at the state level and the roles of state government and the local health department, it is clear that any impetus for changes in current policy will have to come from the Charleston County government or from individual town governments on the islands.

Second, the viability of staying with septic systems, versus extending centralized sewer, needs to be examined. A previous assessment of the viability of centralized sewer on barrier islands in North Carolina concluded that it was better improve septic system management than install centralized sewer (EPA, 1985). A complete assessment of the problem, including costs, primary environmental impacts, secondary land use and environmental impacts, and the collective vision of communities on the islands, should be performed before deciding to sewer areas currently unsewered.

Third, for a new policy to be more effective than current policy, it needs to address the two shortcomings of existing policy: (1) inadequate separation between drain field and ground water and (2) lack of a means to bring existing systems contributing to pollution up to current regulatory standards. If new policies implemented within the Charleston Harbor Project Area are to be a model for programs along the entire coast of South Carolina and a means for the state to facilitate approval of its nonpoint source program under section 6217 of the Coastal Zone Management Act Amendments, the program should address criticisms raised by EPA and NOAA in their preliminary review of the state's program. Specifically, the rules should provide for more stringent regulations near shellfishing beds and other fragile coastal resources. More resources

should be devoted to identifying areas both where systems are currently failing and where systems are likely to cause problems in the future.

Lastly, a new policy needs to take into account septic system problems that occur in low income communities. While choosing a policy, jurisdictions involved should consider any adverse impacts a new policy may have on low income households.

Policy Recommendations

Based upon a review of the constraints facing implementation and available policy options, I have identified a set of recommendations for on-site waste water policy on the islands in the Charleston Harbor Project Area. These recommendations are listed in Table 7.

Table 7. Policy Recommendations for the Charleston Harbor Area

(1) Stay with Septic Systems
(2) Increase Separation to Ground Water
(3) Require Upgrade of Existing Systems Exhibiting Problems
(4) Utilize Alternative Technologies to Minimize Land Use Impacts
(5) Implement Inspection and Maintenance Program
(6) Implement Public Outreach Program
(7) Implement Provisions to Facilitate Approval of Nonpoint Source Program

Stay With Septic Systems

Given the high costs and uncertain benefits associated with sewer, until a formal analysis is conducted which clearly identifies centralized sewer as a better choice than improved septic system management, jurisdictions on the islands should stay with on-site systems and implement more stringent policies.

Increase Separation to Ground Water

Separation to ground water is the most politically contentious aspect of septic system regulation. It is also the factor which has the greatest influence on the risk of ground water contamination posed by an individual system (Cogger 1988, Carlile 1985). South Carolina's six inch separation requirement is the weakest aspect of current policy. Updating the regulations to require two to four feet of separation, as recommended by experts, or three feet, as recommended by EPA in its section 6217 management measures, would be politically untenable.

North Carolina, whose coast is similar to South Carolina's in terms of soils and topography, requires an 18 inch separation to ground water, 12 inches if a pressure distribution system is used. I recommend that the islands adopt this policy as a middle ground between current regulations and rules recommended by EPA and on-site waste water experts. The fact that this policy is being successfully used by a neighboring state should allay any concerns about its feasibility.

One caveat about pressure distribution systems: These systems require more maintenance than existing systems (Hoover, 1992) and should only be implemented if a mechanism exists to ensure their proper function.

Require Upgrade of Existing Problems Exhibiting Problems

Sixty six percent of the systems on the islands were installed prior to 1978, when no regulations regarding separation distance existed. The remainder were installed with only a six inch separation distance to ground water required. Because of the vast difference even a foot

beyond the current six inch regulation can make in a system's ability to remove bacteria, viruses and nutrients, it is critical that any system identified as failing or contributing to ground and surface water pollution are upgraded meet new policy. Upgrading will reduce the chance of failure and the risk of "unseen" pollution from "normally functioning" systems (see section 2).

Provisions should be made to ensure that a policy requiring upgrade does not have unduly disruptive impacts on low-income communities. Two possibilities are: (1) a variance in case of hardship, where the household does not have the resources to upgrade. This variance would require the household only to effectively address the current problem. (2) a cost share program whereby the jurisdiction would share some of the costs of upgrade or repair.

Utilize Alternative and Innovative Technologies to Mitigate Land Use Impacts

To mitigate any undesirable effects that an 18 inch separation distance has on land use restrictions, jurisdictions should test and certify a list of alternative options that a land owner can use in place of a conventional system on unsuitable sites. Model programs include that being used in Kerr County, Texas, Craven County, North Carolina and the state of Florida.

Inspection and Maintenance Programs

Alternative technologies, because they are more complex than conventional systems, frequently require more maintenance (Hoover, 1992). If these systems are approved for use, it is important that measures be taken to ensure their proper function. One option is a periodic inspection program, with inspections performed either by the health department or an authorized entity (Hoover 1992, Carlile 1991). Another option is an operating permit, which an owner can only have renewed if the system has been inspected by an authorized entity (EPA, 1986).

Public Outreach Program

Because changes in septic system regulations have the potential to be contentious, the Charleston Harbor Project, while working with local governments and the public, needs to effectively communicate the benefits associated with more stringent regulations. The new regulations will only affect new systems or systems identified as causing ground and surface water pollution. The benefits include a reduction in the contribution septic systems make to surface water pollution and shellfish bed closures, and a reduced risk of ground water contamination. These benefits need to be emphasized to secure public support for more effective septic system regulations.

Provisions to Facilitate Approval of Nonpoint Source Programs

The opportunity exists for any policy adopted in the Charleston Harbor Project Area to become a model for coastal septic system policy statewide. Such a policy, if adopted statewide, could facilitate the approval of South Carolina's coastal nonpoint source program. If the program implemented in the CHP area is to be such a model, it must address the criticisms made by EPA/NOAA. Specifically, the policy must: (1) provide special provisions to limit septic system use near sensitive waters, such as shellfishing beds. Increasing set back distance to 100 feet near shellfishing beds may serve this function. (2) Devote more resources to identifying areas where systems are currently failing and where systems are likely to fail in the future. The jurisdiction could go about this task in many ways. They could review installation records, soil survey records, identify areas where systems have had problems in the past, etc.

6. Conclusions and Suggestions for Further Research

Implementing more effective septic system regulations at the local level is a daunting task, involving many complex issues. The most critical factor is the attitude of the public towards the changes in land use required by more effective regulations. If a jurisdiction is indifferent to the effects that more stringent regulations will have on land use, or if it considers those effects desirable, implementing a new policy will meet few political obstacles. If the public is averse to land use controls, new regulations will be difficult to implement.

Though the attitude of the public is the most important constraint, the other five constraints discussed in this paper can also be effective barriers to policy implementation. Additional research on several key questions will reduce some of these barriers. These questions include the following:

(1) What are the specific effects of septic system regulations on land use? Public resistance to more stringent regulations is based upon the perceived effect these regulations have on land use. It is commonly believed that implementing more stringent septic system regulations has an adverse effect on development and, consequently, a local jurisdiction's tax base. However, there is no empirical evidence which supports or refutes this claim. Quantifying the effects of septic system regulations on tax base or land use would help to justify or refute unfavorable public attitudes.

(2) How much do septic systems contribute to water pollution? It may be difficult to ever get a precise estimate. However, some effort should be made to obtain estimates based more solidly on scientific evidence than current estimates. A jurisdiction's decision not to upgrade existing regulations can be couched in the rationale that evidence regarding the impact of septic systems on water quality is circumstantial. Obtaining defensible estimates of impacts can help to push the decision as to whether septic systems are problem out of the political arena. Local jurisdictions

can then focus on the question at hand, which is whether the problem merits attention and the benefits and costs associated with specific regulatory actions.

(3) Is staying with septic systems a more viable option than upgrading to centralized sewer? EPA administers sewage treatment construction grants under section 201 of the Clean Water Act. The agency should be assigned the task of creating an analytic framework to help local jurisdiction's decide whether to pursue sewer or stay with septics. This framework should include considerations of cost, primary environmental impacts, secondary environmental and development impacts, and the collective goals of the local community.

As these topics for further research suggest, many uncertainties still surround septic system policy. Decisions must be made under these uncertainties. This document helps to identify the salient issues in septic system management, present current evidence and theory on some of these issues, and illustrate policies several states and local jurisdictions have implemented to deal with the problem. In sum, this document provides a comprehensive definition of the problem with septic system management and a sampling of the range of options available to address the problem. It is hoped that this information will serve to remove some of the barriers to better septic system management and lead to more informed policy decisions.

List of Interviewees

Angoli, Tricia
Staff Librarian, EPA Small Flows Clearinghouse. March, 1994.

Calk, Steve
Tri-County Health Department, Charleston South Carolina. April 1994.

Montgomery, Allen
Head, On-site Wastewater Branch (Large Systems). April 1994.

Robinson, Heyward
Director, Charleston Harbor Project
Charleston, South Carolina. February and March, 1994.

Rubin, A. Robert
Department of Biological and Agricultural Engineering
North Carolina State University. March, 1994.

Shiles, Gene.
Researcher, Coastal Zone Management Act Amendments Implementation.
School of the Environment, Duke University. April, 1994.

Steinbeck, Steve
Head, On-Site Wastewater Branch,
North Carolina Department of Health, Environment and Natural Resources.
February, 1994.

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